APPENDIX 5-9 - HEC-HMS MODEL INPUT AND OUTPUT FILES WITH DESCRIPTION

5-9.1 MODEL INPUT AND ASSUMPTIONS

The model is comprised of three integrated sub models: a basin model, a meteorological model, and a control specifications model. The basin model contains the schematic of the area of interest utilizing various icons to represent the sub-basins, reservoirs or pump stations, storage nodes, and reaches or canals. The meteorological model includes the various rainfall events of interest. And the control specifications model includes details such as run period and time steps. Discussion of each of these sub models follows.

Each sub-basin must include three components: the watershed size, loss rate, and transform, where the size of the sub-basin is input in square miles.

The loss rate component estimates how much rainfall (PMP) is converted into excess runoff (PMF). The loss rate can be determined using many different methods. The SCS curve number method was chosen to estimate the loss rate for this model. The SCS curve number is found by utilizing soil surveys and the SCS curve number tables. It was concluded that the soil type is comprised mostly of various types of muck soils. A SCS curve number value of 86 was determined using the SCS curve number table under farming and row crops heading for the EAA area studied.

In addition to the SCS curve number for determining the loss rate, a value for the percentage of impervious land and an initial loss value must also be entered into the basin model. Most of the modeled land area is used for agricultural purposes; therefore, the percentage of impervious land was always kept under 10 percent. Lastly, the initial loss value was left blank to let the HMS model determine the amount (function of the SCS curve number).

In the final component of the sub-basin model requirements, the transform, the SCS lag-time was used to simulate the temporal response throughout each of the sub-basins. These lag times were initially calculated using the Mannings Equation[1]. Then the resulting peak flow out put was compared to the Crippen & Bue maximum peak runoff method (Crippen, et al 1977). Using an iterative process, HMS lag times were adjusted to produce peak flows within 20% of the Crippen & Bue values.

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[1]Mannings Equation
$v = 1/n \times R^{2/3} \times S^{1/2}$

Where :
n = coefficient of roughness
v = Water velocity down the channel (ft /sec) = flow (ft^3sec-1) / cross sectional area (ft^2)
R = Hydraulic radius (ft) = cross sectional area (ft^2) / wetted perimeter (ft)
S = Gradient of channel (ft/ft)

As mentioned above, various icons are used to represent different components of the basin. For example, reaches were used to simulate the canals and lag times were used in the reaches to represent the routing method. The canal lengths and the average velocity of the flow were used to calculate the lag times.

Subbasins are represented by storage nodes in the basin model, with exception to reservoir A-1 (reservoir A-1 is actually a reservoir). The input variables for the storage nodes include stage, volume, and outflow. The outflow rate for each storage node was set to the maximum permitted capacity as referenced in the *Interim Summary Technical Memorandum* (Burgi et al. 2005).

The A1 reservoir inputs include stage and volume. The outflow was set to 0 for reasons discussed in the *Interim Summary Technical Memorandum* (Burgi et al., 2005). The schematic shows the A-1 reservoir attached to a source node instead of a sub basin. The source node is used to apply specific PMP rain events to the reservoir.

Several meteorological sub models were designed to replicate different PMP events discussed in the *Interim Summary Technical Memorandum* (Burgi et al., 2005).

Finally, the control specifications sub model was set to 60 days.

5-9.2 MODEL OUTPUT

The model output is generally viewed in one of two ways; either in a Global Summary Table or at each node for specific calculations.

The Global Summary Table highlights Peak Discharge, Time of Peak Discharge, Total Volume, and Drainage.

All the nodes in the model show three different kinds of results: Graph Section, Time Series Table, and Summary Table. Each Table has a different output depending on which node is being assessed. The complete list of output parameters may be referenced in the HEC-HMS Users Manual sown in Appendix 5-8. To view run specific output from the HMS EAA model, see the printouts included herein. A copy of the HEC-HMS program and input/output files are also be included in Appendix 5-12 to be provided separately.

Sub-basin nodes show the following:

- Graph Section
  - Flow through time
- Time Series table
  - Precipitation
  - Loss, Excess
  - Direct Q (cfs)
  - Base flow values for every ten minute interval in the simulation run
- Summary Table
  - Peak Discharge
  - Time and Date of Peak Discharge
  - Total Precipitation
  - Total Direct Runoff
  - Total Loss

  - Total Base Flow
  - Total Excess
  - Total Discharge

Reservoir nodes show the following:

- Graph Section
  - Flow over time
  - Storage over elevation
- Time Series Table provides the following for every10 minute interval of the simulation run:
  - Inflow
  - Outflow
  - Storage
  - Elevation
- Summary Table
  - Peak Inflow
  - Peak Outflow
  - Date and Time of the Peak Inflow
  - Date and Time of the Peak Outflow
  - Total Inflow
  - Total Outflow
  - Peak Storage
  - Peak Elevation

Reach nodes shows the following:

- Graph Section
  - Flow over time
- Time Series Table
  - Inflow and Outflow in ten minute intervals
- Summary Table
  - Peak Inflow
  - Peak Outflow
  - Date and Time of the Peak Inflow
  - Date and Time of the Peak Outflow
  - Total Inflow
  - Total Outflow

Sink nodes of the model shows the following:

- Graph Section
  - Flow through time to allow us to see when reservoirs turned on and off
- Time Series Table
  - Inflow in ten minute intervals
- Summary Table
  - Peak inflow
  - Date and Time of the Peak Inflow
  - Total inflow

HMS * Summary of Results

Project : EAA reservoir **Run Name : Final_Run1_NNRC**

Start of Run	**: 01May05 0000**	**Basin Model**	**: NNRC pump 2**
End of Run	**: 01Jul05 0000**	**Met. Model**	**: 72hr 42.7 inches**
Execution Time	**: 06Jul05 1318**	**Control Specs**	**: 60days**

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
STA 3/4	50270	02 May 05 1900	60384	27.351
STA pump	167.00	02 May 05 0500	19812	27.351
N-1	38261	02 May 05 1700	36291	16.660
N-1 pump	1923.0	02 May 05 0400	33692	16.660
Source-1	116097	02 May 05 1500	57918	24.780
Reservoir pump	0.0	30 Apr 05 2400	0.0	24.780
N-2	85849	02 May 05 2200	126842	58.214
N-2 pump	2378.0	02 May 05 0900	117583	58.214
N-3	47959	03 May 05 0100	90959	41.755
N-3 pump	2589.0	02 May 05 1300	84324	41.755
Bolles NNRC	17654	02 May 05 1900	19000	8.722
Bolles pump	459.00	02 May 05 0500	17615	8.722
Bolles canal	459.00	02 May 05 0700	17615	8.722
N-4	38861	02 May 05 1700	35334	16.176
N-4 pump	1163.0	02 May 05 0300	32775	16.176
C-1	32100	02 May 05 1800	33068	15.180
C-1 pump	853.00	02 May 05 0500	30666	15.180
Cross Canal	853.00	02 May 05 0700	30666	15.180
Junction-1	2475.0	02 May 05 0700	81057	40.078
Reach-1	2475.0	02 May 05 1000	81057	40.078
Junction-2	5064.0	02 May 05 1300	165381	81.833
Reach-2	5064.0	02 May 05 1700	165381	81.833
Junction-3	7442.0	02 May 05 1700	282964	140.047
Reach-3	7442.0	02 May 05 1800	282964	140.047
Junction-4	7442.0	02 May 05 1800	282964	164.827
Reach-5	7442.0	02 May 05 1900	282964	164.827
Junction-5	9365.0	02 May 05 1900	316656	181.487
Reach-4	9365.0	02 May 05 2200	316656	181.487
Junction-6	9532.0	02 May 05 2200	336468	208.838
Sink-1	9532.0	02 May 05 2200	336468	208.838

HMS * Summary of Results

Project : EAA reservoir **Run Name : Final_Run1_Miami**

Start of Run : 01May05 0000 **Basin Model : MIA pumps 2**
End of Run : 01Jul05 0000 **Met. Model : 72hr 42.7 inches**
Execution Time : 06Jul05 1323 **Control Specs : 60days**

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
M-5	37245	02 May 05 1800	35449	16.273
M-5 pump	354.00	02 May 05 0400	32856	16.273
L-3	354.00	02 May 05 0800	32856	16.273
M-2	81398	02 May 05 2100	118160	54.292
M-2 pump	1645.0	02 May 05 0900	109529	54.292
M-3	70734	02 May 05 2100	102759	47.172
M-3 pump	1266.0	02 May 05 0900	95260	47.172
M-4	71591	02 May 05 2000	90744	41.638
M-4 pump	1588.0	02 May 05 0700	84125	41.638
B-1	14562	02 May 05 1700	12937	5.936
B-1 miami pump	312.00	02 May 05 0300	11991	5.936
Bolles canal	312.00	02 May 05 0500	11991	5.936
Junction-1	1900.0	02 May 05 0700	96116	47.574
Miami canal top	1900.0	02 May 05 0900	96116	47.574
Junction-3	3166.0	02 May 05 0900	191376	94.746
Miami canal 2nd	3166.0	02 May 05 1200	191376	94.746
Junction-2	4811.0	02 May 05 1200	300905	149.038
Miami canal 3rd	4811.0	02 May 05 1400	300905	149.038
M-1	67508	02 May 05 2100	94467	43.406
M-1 pump	1253.0	02 May 05 0800	87565	43.406
Junction-4	6064.0	02 May 05 1400	388469	192.444
Miami Canal 4th	6064.0	02 May 05 1800	388469	192.444
Junction-6	6064.0	02 May 05 1800	388469	192.444
Junction-5	6418.0	02 May 05 1800	421326	208.718
Sink-1	6418.0	02 May 05 1800	421326	208.718

HMS * Summary of Results

Project : EAA reservoir **Run Name : Final_Run2&3_NNRC**

Start of Run	**: 01May05 0000**	**Basin Model**	**: NNRC pump 2**
End of Run	**: 01Jul05 0000**	**Met. Model**	**: RUN 2**
Execution Time	**: 06Jul05 1324**	**Control Specs**	**: 60days**

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
STA 3/4	49759	02 May 05 1900	59620	27.351
STA pump	167.00	02 May 05 0500	19812	27.351
N-1	37892	02 May 05 1700	35826	16.660
N-1 pump	1923.0	02 May 05 0400	33215	16.660
Source-1	116097	02 May 05 1500	57918	24.780
Reservoir pump	0.0	30 Apr 05 2400	0.0	24.780
N-2	84920	02 May 05 2200	125217	58.214
N-2 pump	2378.0	02 May 05 0900	115952	58.214
N-3	47415	03 May 05 0100	89794	41.755
N-3 pump	2589.0	02 May 05 1300	83212	41.755
Bolles NNRC	17477	02 May 05 1900	18757	8.722
Bolles pump	459.00	02 May 05 0500	17374	8.722
Bolles canal	459.00	02 May 05 0700	17374	8.722
N-4	38493	02 May 05 1700	34883	16.176
N-4 pump	1163.0	02 May 05 0400	32318	16.176
C-1	31783	02 May 05 1800	32644	15.180
C-1 pump	853.00	02 May 05 0500	30243	15.180
Cross Canal	853.00	02 May 05 0700	30243	15.180
Junction-1	2475.0	02 May 05 0700	79934	40.078
Reach-1	2475.0	02 May 05 1000	79934	40.078
Junction-2	5064.0	02 May 05 1300	163146	81.833
Reach-2	5064.0	02 May 05 1700	163146	81.833
Junction-3	7442.0	02 May 05 1700	279098	140.047
Reach-3	7442.0	02 May 05 1800	279098	140.047
Junction-4	7442.0	02 May 05 1800	279098	164.827
Reach-5	7442.0	02 May 05 1900	279098	164.827
Junction-5	9365.0	02 May 05 1900	312314	181.487
Reach-4	9365.0	02 May 05 2200	312314	181.487
Junction-6	9532.0	02 May 05 2200	332126	208.838
Sink-1	9532.0	02 May 05 2200	332126	208.838

HMS * Summary of Results

Project : EAA reservoir Run Name : Final_Run2&3_Miami

Start of Run : 01May05 0000 Basin Model : MIA pumps 2
End of Run : 01Jul05 0000 Met. Model : RUN 2
Execution Time : 06Jul05 1324 Control Specs : 60days

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
M-5	36884	02 May 05 1800	34995	16.273
M-5 pump	354.00	02 May 05 0400	32404	16.273
L-3	354.00	02 May 05 0800	32404	16.273
M-2	80524	02 May 05 2100	116645	54.292
M-2 pump	1645.0	02 May 05 0900	108008	54.292
M-3	69975	02 May 05 2100	101443	47.172
M-3 pump	1266.0	02 May 05 0900	93945	47.172
M-4	70845	02 May 05 2000	89582	41.638
M-4 pump	1588.0	02 May 05 0700	82949	41.638
B-1	14426	02 May 05 1700	12771	5.936
B-1 miami pump	312.00	02 May 05 0400	11826	5.936
Bolles canal	312.00	02 May 05 0600	11826	5.936
Junction-1	1900.0	02 May 05 0700	94774	47.574
Miami canal top	1900.0	02 May 05 0900	94774	47.574
Junction-3	3166.0	02 May 05 0900	188720	94.746
Miami canal 2nd	3166.0	02 May 05 1200	188720	94.746
Junction-2	4811.0	02 May 05 1200	296728	149.038
Miami canal 3rd	4811.0	02 May 05 1400	296728	149.038
M-1	66788	02 May 05 2100	93256	43.406
M-1 pump	1253.0	02 May 05 0800	86363	43.406
Junction-4	6064.0	02 May 05 1400	383091	192.444
Miami Canal 4th	6064.0	02 May 05 1800	383091	192.444
Junction-6	6064.0	02 May 05 1800	383091	192.444
Junction-5	6418.0	02 May 05 1800	415495	208.718
Sink-1	6418.0	02 May 05 1800	415495	208.718

HMS * Summary of Results

Project : EAA reservoir **Run Name : Final_Run4_NNRC_Litl**

Start of Run	**: 01May05 0000**	**Basin Model**	**: NNRC small2**
End of Run	**: 01Jul05 0000**	**Met. Model**	**: RUN 5**
Execution Time	**: 06Jul05 1334**	**Control Specs**	**: 60days**

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
N1	19671	02 May 05 1900	20593	8.710
N-1 pump	1923.0	02 May 05 1100	17959	8.710
Source-1	162632	02 May 05 1500	63456	24.780
Reservoir pump	0.0	30 Apr 05 2400	0.0	24.780
N-2	88137	02 May 05 2300	137666	58.214
N-2 pump	2378.0	02 May 05 1000	128437	58.214
N-3	53410	03 May 05 0100	98723	41.755
N-3 pump	2589.0	02 May 05 1200	92106	41.755
C-1	28037	02 May 05 1700	22801	9.644
C-1 pump	853.00	02 May 05 0700	20387	9.644
Cross Canal	853.00	02 May 05 0900	20387	9.644
Junction-1	853.00	02 May 05 0900	20387	9.644
Reach-1	853.00	02 May 05 1200	20387	9.644
Junction-2	3442.0	02 May 05 1200	112494	51.399
Reach-2	3442.0	02 May 05 1600	112494	51.399
Junction-3	5820.0	02 May 05 1600	240930	109.613
Reach-3	5820.0	02 May 05 1700	240930	109.613
Junction-4	5820.0	02 May 05 1700	240930	134.393
Reach-5	5820.0	02 May 05 1800	240930	134.393
Junction-5	7743.0	02 May 05 1800	258889	143.103
Reach-4	7743.0	02 May 05 2100	258889	143.103
Junction-6	7743.0	02 May 05 2100	258889	143.103
Sink-1	7743.0	02 May 05 2100	258889	143.103

HMS * Summary of Results

Project : EAA reservoir **Run Name : Final_Run4_Miami(ltl**

Start of Run : 01May05 0000 **Basin Model : MIA small2**
End of Run : 01Jul05 0000 **Met. Model : RUN 5**
Execution Time : 06Jul05 1303 **Control Specs : 60days**

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
M-2	92326	02 May 05 2200	128254	54.292
M-2 pump	1645.0	02 May 05 0800	119635	54.292
M-3	57497	02 May 05 2000	68812	29.105
M-3 pump	1266.0	02 May 05 1100	61312	29.105
Junction-3	1266.0	02 May 05 1100	61312	29.105
Miami canal 2nd	1266.0	02 May 05 1400	61312	29.105
Junction-2	2911.0	02 May 05 1400	180947	83.397
Miami canal 3rd	2911.0	02 May 05 1600	180947	83.397
M-1	76802	02 May 05 2100	102538	43.406
M-1 pump	1253.0	02 May 05 0800	95633	43.406
Junction-4	4164.0	02 May 05 1600	276580	126.803
Miami Canal 4th	4164.0	02 May 05 2000	276580	126.803
Junction-6	4164.0	02 May 05 2000	276580	126.803
Junction-5	4164.0	02 May 05 2000	276580	126.803
Sink-1	4164.0	02 May 05 2000	276580	126.803